# The Stability Of The Money Demand Function In South Africa: A VAR-Based Approach

Forget Mingiri Kapingura, University of Fort Hare, South Africa

**ABSTRACT**

*The study examined the stability of the money demand function in South Africa using quarterly data from 1994 to 2012. The Johansen co-integration test and the Vector Error Correction Model were used to analyse the long-run and the short-run interaction between the variable. The CUSUM and CUSUMSQ were also used to examine the stability of the South African money demand function. The Johansen co-integration test proved that there exists a long-term relationship between the money demand function and its determinants in South Africa. However, the CUSUM and CUSUMSQ proved that the South African money demand function was unstable over the period from 2003 to 2007. This therefore justifies the use of the repo rate as a monetary policy tool as compared to the monetary aggregates.*

**Keywords**: Money Demand; Johansen Co-integration; South Africa

## INTRODUCTION

Examining the stability of the money demand function is an area which has received attention at both the academic and policy discourse. This is supported by a number of studies (Friedman, 1959; Bahmani-Oskooee and Sin, 2002; Poole, 2006; Doguwa et al., 2014). However, results have been varied. The interest in this area stems from the extent to which a stable money demand function determines the credibility and effectiveness of monetary policy in any country.

A stable money demand makes it possible to establish the link between monetary aggregates and nominal income (Doguwa et al., 2014). In other words, a stable money demand function makes it possible for the Reserve bank to achieve its monetary policy goals and also promote economic growth. This becomes important, especially in the presence of exogenous shocks to the monetary system, like what was experienced during the 2008/2009 Global financial crisis.

In South Africa, it is important to note that the country has undergone a series of monetary policy regimes, from the liquid asset based in the 1960s to the inflation targeting regime currently being used. Mutsau (2013) argues that changes in monetary policy regimes are likely to cause changes in the estimated parameters of the money demand function and this will likely render policy simulation redundant. Also, in the event that there are new forms of money, such as electronic, a money demand function that was estimated in previous periods may not be stable. This becomes important when taking into account the major developments in the South African financial sector.

Given this background, this study aims to establishing the money demand function in South Africa, also taking into account the changes that have taken place in the financial sector. It is also important to note that there arequite a number of studies which have been carried out in the case of South Africa. However, a study reviewing the literature on South Africa by Niyimbanira (2013) shows that the majority of available studies on the stability of money demand did not use cointegration. Therefore, this study seeks to establish the determinants of the money demand function in South Africa employing the Johansen co-integration test. Onafowora and Owoye (2011) argue that the Johansen co-integration is a useful tool in analysing the demand for money in both the developed and developing countries. However, with regard to the stability of the parameters in the model, the study will employ the CUSUM and CUSUMQ tests which were developed by Brown et al. (1975) since a number of studies (Bahmani-Oskooee and Shin, 2002; Onafowora and Owoye, 2011) argue that the Johansen co-integration test is not informative regarding the stability of the parameters in the model. The CUSUM and the CUSUMQ test will be used to examine the short-run and long-run coefficients of the money demand function.

The study is organised into six sections: the introduction, a section providing an overview of the South African monetary policy framework, a review of the available literature in South Africa, a discussion of the methodology to be used in the study, a presentation of the results and a discussion, and the summary and conclusion.

## Evolution Of The Current Monetary Policy Framework In South Africa

South Africa has employed three monetary regimes since the 1960s as illustrated in Table 1.

**Table 1:** Monetary Policy Regimes in South Africa

| Years | Monetary Policy Regimes |
|---|---|
| 1960 – 1981 | Liquid asset based-ratio |
| 1981 – 1985 | Mixed System |
| 1986 – 1998 | Cost of cash reserves-based system with pre-announced monetary targets (M3) |
| 1998 to date | Daily tenders of liquidity through repo transactions and inflation targeting |

Source: Aron and Muellbauer (2006)

Aron and Muellbauer (2006) show that under the cash reserve system, the South African Reserve bank's discount rate would influence the cost of overnight collateralised lending, as well as other market interest rates. The central bank would also influence the supply of credit through open market operations and other various policies on overall liquidity. The central bank could also create a money market shortage and set the bank rate to be relatively higher, which could ultimately influence the commercial rates to be closely linked to the bank rate. Thus, under this system, monetary control operated indirectly through slowing the demand for money.

In 1986, the central bank adopted the monetary targets following the recommendation of the de Lock Commission (1985). In this regime, targets were set annually employing a three-month moving average of broad money growth. The targets were announced in the March budget so as to cover the period of the fourth quarter of the current year from the fourth quarter of the previous year. The way the target was designed aimed at accommodating projected real GDP growth as well as to contain inflation. However, Aron and Muellbauer (2006) argue that the procedure of choosing the target was not transparent. Also, the use of the targets diminished following extensive polices of financial liberalization, which was also coupled with large capital flows from 1994.

In 1998, a system of monetary accommodation was introduced in which the repurchase (repo) rate was determined by the market through repurchase transactions. Stals (1999) shows that when the central bank would fully estimate the daily requirements of banks, that would indicate a neutral position with over or under provision signalling a preference for stabilising the repo rate.

Aron and Muellbauer (2006) show that in the late 1990s and early 2000s, the money market was dominated by a few large banks and it was poorly performing. This had an effect on the extent to which the interbank rate would be effective as a monetary policy tool. This was corrected through the addition of several banks in 2005. Also, the spread between the interbank rate and the repo rate was altered with a 100 basis point fall in the repo rate. Therefore, the repo rate is currently fixed to eliminate any ambiguity about the SARB policy signals under the formal inflation targeting regime.

However, the inflation targeting regime has been criticised by labour unions, such as the COSATU, as not being supportive of economic growth as well as propagating the high levels in unemployment. This is consistent with Poole (2006) who argues that an inflation targeting regime is likely to turn the Central bankers into 'inflation nutters'; in other words, they would concentrate more on inflation though in can be detrimental to stable economic growth, employment, and exchange rates. This becomes apparent given the high levels of unemployment, sluggish growth, and an exchange rate that has been depreciating against major currencies.

## REVIEW OF RELEVANT LITERATURE AND THEORETICAL FRAMEWORK

There are quite a number of studies that have been carried out to establish the determinants of the money demand function. The increase in the number of studies that have examined the determinants of the money demand function lies on the extent to which money demand impacts on the effectiveness of monetary policy. This section reviews the studies on the money demand function which have been done in South Africa.

Of the available studies, Niyimbanira (2013) argues that those done in South Africa can be categorised under four approaches to examining the demand for money: 1) those employing the co-integration technique, 2) studies based on the partial stock adjustment model, 3) studies based on the linear function approach, and 4) the studies that are based on the buffer-stock model.

Of those studies which employed the Johansen co-integration technique, Hurn and Muscatelli (1992) examined the money demand function in South Africa for the period 1965 to 1990 using quarterly data. The authors used M3 as a measure of money with real income proxied with GDP and the commercial deposit rate and the interest on the three-year government stock. The empirical results revealed that there was a presence of a long-term relationship between M3 and its determinants as specified in the model. All the variables estimated in the model had the correct signs. That implied, therefore, that the money demand function in South Africa is stable. However, this study has been criticised for using nominal M3 instead of real money.

Moll (2000) carried out a study on the determinants of the money demand function in South Africa employing real variables as opposed to the model of Hurn and Muscatelli. The author employed three techniques in testing for co-integration - the Johansen-Juselius trace test, the Hendry/PcGive unit root test and the Engle and Granger method. Results from the three tests exhibited that there was a long-term relationship between the money demand function and its determinants. Therefore, the author concluded that the money demand function in South Africa is stable and the co-integration approach was the best in predicting the parameter estimates in the money demand model. However, the author noted that for the period 1993 to 1998, M3 increased by about 39% when real income grew at 11%. The author's results suggest that there was no structural change within this period. However, this can be challenged as that was the same time of the transition from the Apartheid regime to democracy in South Africa which is likely to have influenced the money demand function as more people had access to the financial sector, hence increasing the demand for money.

Studies that employed the partial stock adjustment model include Maxwell (1971), Stadler (1981), Contogiannis and Shahi (1982), Courakis (1984), and Whittaker (1985). The majority of these studies concluded that the money demand function in South Africa is not stable. Another interesting observation that emanated from these models is that unlike the traditional theories on the money demand function, the price level was discovered to be significant as compared to the interest rate effect. However, this approach has been criticised on the basis of suffering from specification problems and also being highly restrictive.

Studies that employed the linear function include Heller (1966) who found out that the inclusion of the price level amongst the independent variables increased the explanatory power of the money demand equation. Other authors who employed the same approach include Maxwell (1971) and Stadler (1981). However, this methodology suffered from a number of shortcomings, as highlighted by Contogiannis and Shahi (1982) who, having established that the majority of the studies that employed the linear models did not show a stable estimated specification of the money demand, concluded that the relationship may be non-linear and therefore non-liner estimation techniques may be the relevant modelling technique.

Talvas (1989) employed the buffer stock as an alternative to the linear model in examining the money demand function in South Africa for the period 1977 to 1987. The author learned that all the coefficients in the model were statistically significant and they all supported that the money demand function in South Africa is stable. However, Talvas questioned the model given that the money supply variable is completely endogenous on the interest rate in South Africa. Due to this, the buffer stock variable was considered inappropriate.

The review of literature of the studies carried out in South Africa indicates that there are quite a number of studies which have examined the stability of the money demand function. However, some of the studies have suffered from methodological techniques. Thus, this study examined the stability of the money demand employing the Johansen co-integration test, as well as the CUSUM and CUSUMSQ tests, which were developed by Brown et al. to examine the stability of the short-run dynamics as well as the long-run coefficients of the money demand function.

## DATA AND METHODOLOGY

The study was based on a model developed by Onofowo and Owoye (2011) which is based on the open economy portfolio balance approach of money demand, as in Thomas (1985) and Handa (2000). The model postulates that agents hold money either as an inventory, so as to smooth the differences between income and expenditure, or because of its return as an asset in a portfolio. Either of the two motives suggests that the demand for money may depend on a scale of variables, such as real income or wealth, as well as the returns to money and alternative assets. Open economy macroeconomics suggests that the return on money in an open economy consists of both domestic and foreign assets. Given that the South Africa economy is open, the model to be employed in the study can be estimated as follows:

$$\ln \Delta\left(\frac{M}{P}\right)_t = \alpha_0 + \alpha_1 \ln Y_t + \alpha_2 R_t + \alpha_3 \ln \pi_t + \alpha_4 \Delta \ln FX_t + \alpha_5 Rf_t + e_t \tag{1}$$

where *ln* is the natural logarithm, *m* is the nominal M3 money stock, *P* is the domestic price level, $(M/P)_t$ is the demand for real M3 money balances, and $Y_t$ is a scale of variables (income) proxied by real GDP. *R* is the domestic interest rate measuring the own rate of return of interest and $\pi$ is the inflation rate which measures the return on real assets. Friedman argues that in an inflationary environment, the purchasing power of money erodes quickly whilst that of real assets is maintained. Therefore, economic agents may wish to switch from money into real assets. $FX_t$ represents the exchange rate. A number of studies support the use of the exchange rate and foreign interest to capture the foreign sector. The expected exchange rate captures the substitution between domestic and foreign currencies. However, a number of studies argue that its effect is ambiguous. Bahmani-Oskooee and Rhee (1994) argue that if residents evaluate their assets in terms of the domestic currency, a depreciation of the currency will increase their foreign holdings and hence increase their wealth. However, in a bid to maintain a fixed share of the wealth invested, residents may shift parts of their holdings to domestic currency. This will result in an increase in the demand of the domestic currency. On the other hand, Onofowo and Owoye (2011) argue that if depreciation leads to economic agents anticipating further depreciation, as a hedge against exchange rate risk, they may demand more foreign currency as opposed to the riskier domestic currency. This will result in a decline in the demand for money. R*f* is the foreign interest rate. Studies such as Ibrahim (2001) argue that an increase in interest rate increases the returns on foreign assets relative to the domestic assets. This may result in agents' appetites for domestic assets decreasing, hence a decrease in the domestic money demand. The apriori expectations of the coefficients can be summarised as $\alpha_1 > 0$; $\alpha_2 > 0$; $\alpha_3 < 0$; $\alpha_4 < 0$ with $\alpha_5$ either $\alpha_5 < 0$ or $\alpha_5 > 0$.

The study utilised quarterly data from 1995:1 to 2012:4. The data were collected from the South African Reserve Bank and the IMF's International Financial Statistics website. The real M3 money demand was proxied by M3 money stock divided by the consumer price index (CPI), the real income variable was proxied with real GDP data at 2005 constant prices, and the domestic interest rate was proxied with the South African Treasury bill rate. CPI is the quarterly inflation rate that is derived from the quarterly percentage rate change in the CPI. Since South Africa trades more with the US, the US Treasury bill rate was used as a proxy for the foreign interest rate and the Rand/US exchange rate was used as a measure of the exchange rate.

## ESTIMATION TECHNIQUES

In modelling the money demand function in South Africa, the variables to be employed in the study were examined for their time series properties of the data using the Augmented Dickey Fuller (ADF) test and the Phillips Perron (PP) test. The ADF test is based on the following regression:

$$\Delta X_t = \delta_0 + \delta_1 t + \delta_2 X_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta X_{t-1} + u_i \tag{2}$$

where Δ is the first difference operator, $X_t$ is the natural logarithm of the series $\delta_1$, $\delta_2$, and $\alpha_i$ to be estimated. $U_t$ is the error term. The null hypothesis of a unit root will be tested against an alternative hypothesis of no unit root. The PP test will take precedence over the ADF test as it does not require assumptions regarding homoscedasticity of the error term and corrects for serial correlation.

Having established the order of integration of the variables, co-integration tests were carried out using the Johansen co-integration test. Following the Johansen procedure, the test can be represented as follows:

$$\Delta Y_t = \Pi_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-1} + BX_t + e_t \tag{3}$$

The model asserts that if the coefficient matrix Π has reduced Rank, r < k, then there exists k×r matrices - α and β - each with rank r, such that $\Pi = \alpha\beta^{'}$ and $\beta' Y_t$ is I(0). The co-integrating rank, which will be identified using the trace statistic and the max-eigenvalue, is r. Each column of β represents a co-integrating vector - α represents the adjustment parameters in the VECM and $\Gamma_i$ captures the short-run dynamics of the time series.

In the event that there is co-integration, a Vector Error Correction Model (VECM) will be estimated to examine how the system adjusts to the long-run equilibrium, which is implied by the co-integrating equation. The VECM is of the following form:

$$\begin{aligned} \ln \Delta\left(\frac{M}{P}\right)_t = \alpha_0 + \sum_{i=0}^{k-1} \alpha_1 \Delta \ln Y_{t-1} + \sum_{i=0}^{k-1} \alpha_2 R_{t-1} + \sum_{i=0}^{k-1} \alpha_3 \ln \pi_{t-1} + \sum_{i=0}^{k-1} \alpha_4 \Delta \ln FX_{t-1} + \\ \sum_{i=0}^{k-1} \alpha_5 Rf_{t-1} + \sum_{i=0}^{k-1} \alpha_6 \ln \Delta\left(\frac{M}{P}\right)_{t-1} \alpha_7 EC_{t-1} + \mu_t \end{aligned} \tag{4}$$

$EC_{t-1}$ represents the error correction term from Equation 1 and μ is a white noise error term.

Having estimated the VECM for the South African money demand model, the next step will be to investigate the stability of the money demand model. This will be examined through the CUSUM and CUMSUMSQ tests proposed by Brown et al. (1975). The CUSUM test is estimated as follows:

$$W_t = \sum_{j=k+1}^{t} \frac{\hat{\epsilon}_j}{\hat{\sigma}_\epsilon} \tag{5}$$

where $\hat{\epsilon}_j$ is the recursive residual term and $\hat{\sigma}_\epsilon$ is the standard deviation of the recursive residual term, which is defined as:

$$\hat{\sigma}_\epsilon \sqrt{\left(\frac{1}{T-k} \sum_{t=1}^{T} (\epsilon_t - \hat{\epsilon}\right)^2)}$$

In order to obtain robust results, the Cumulative Sum of Squares test will also be applied. The test can be estimated as follows:

$$S_t = (\sum_{r=k+1}^{t} \omega_\tau^2$$

where $\omega$ is the recursive residual, which is computed for t=k+1,.........,T. The expected value of $S_t$ under the hypothesis of parameter constancy is given as:

$$E(S_t) = (t-k)/(T-k) \tag{6}$$

This ranges from zero at t=k to unity at t=T. Doguwa et al. (2014) state that the significance of the departure of S from its expected value is assessed by looking at a pair of parallel straight lines around the expected value. The test statistic will be plotted alongside the 5% critical lines. In the event that the cumulative sum of squares goes out of the area between the two critical lines, it will be an indication of parameter instability.

## RESULTS AND DISCUSSION

### Unit Root Test Results

The unit root test results are reported in Tables 2 and 3. The test was conducted to determine the order of integration of the variables. Table 2 illustrates that the null hypothesis of unit root cannot be rejected on all the variables used in the model. However, at first difference, all variables were found to be stationary from both the ADF and the PP.

**Table 2:** Level Series

| | ADF | | PP | |
|---|---|---|---|---|
| **Variable** | **Intercept** | **Trend and Intercept** | **Intercept** | **Trend and Intercept** |
| Lrm3 | -1.539494 | -3.439928* | -1.574781 | -2.073596 |
| lrgdp | -1.660617 | -2.066732 | -1.658715 | -1.452357 |
| Ltbill-sa | -2.213562 | -2.703372 | -2.130291 | -2.113061 |
| lexrate | -0.417073 | -1.916395 | -0.436361 | -2.170652 |
| lcpi | 0.337237 | -1.553336 | 0.210364 | -1.875967 |
| Ltbill-us | -2.583377 | -3.025835 | -0.872574 | -1.277433 |

Note: *, ** and *** indicates significance at 1%, 5% and 10% significance level

**Table 3:** First Difference Series

| ADF | | PP | |
|---|---|---|---|
| **Intercept** | **Trend and Intercept** | **Intercept** | **Trend and Intercept** |
| -7.514167*** | -7.593763*** | -7.721315*** | -7.701046*** |
| -3.113046** | -3.905893** | -15.92005*** | -17.72213*** |
| -4.308469*** | -4.288479*** | -4.308469*** | -4.288479*** |
| -4.359900*** | -4.366536*** | -8.216002*** | -8.166390*** |
| -7.368814*** | -7.355116*** | -7.751932*** | -7.721825*** |
| -3.858378*** | -4.063596** | -6.569908*** | -6.657146*** |

Having established the presence of co-integration, a Vector Error Correction Model (VECM) was estimated to examine how the system adjusts to the long-run equilibrium, which is implied by the co-integrating equation. Table A in the Appendix shows that a lag of 2 was chosen by the majority of the information criterions. Based on a lag of 2, the Johansen co-integration test was estimated and the results are reported in Panel A of Table 4.

Based on both the Trace statistic and the Maximum eigenvalue, the null hypothesis of no co-integration is rejected. The results suggest that there exists a long-term relationship linking real M3 and its macroeconomic determinants, as specified in the model. In other words, the results indicate that there exists a unique long-run relationship between *M3/P, rgdp, ltbillsa, lcpi, lexrate* and *lusbill.* The existence of the long-run co-integrating vector implies that an economic interpretation of the long-run broad money demand function can be made by normalising the estimates on M3/P. The parameter estimates, which represent the long-run elasticities of the co-integrating vector, are reported in Panel B of Table 4.

**Table 4:** Johansen Maximum Likelihood Co-integration

| **Panel A: Johansen Maximum Likelihood Co-integration Test Results** | | | | |
|---|---|---|---|---|
| *Unrestricted Co-integration Rank Test (Trace)* | | | | |
| **Hypothesized No. of CE(s)** | **Eigenvalue** | **Trace Statistic** | **0.05 Critical Value** | **Prob.**** |
| None * | 0.600711 | 160.2067 | 103.8473 | 0.0000 |
| At most 1 * | 0.437371 | 89.51529 | 76.97277 | 0.0040 |
| At most 2 | 0.250024 | 45.22992 | 54.07904 | 0.2413 |
| At most 3 | 0.185502 | 23.07590 | 35.19275 | 0.5233 |
| At most 4 | 0.054275 | 7.276786 | 20.26184 | 0.8789 |
| At most 5 | 0.037961 | 2.979949 | 9.164546 | 0.5844 |
| *Unrestricted Co-integration Rank Test (Maximum Eigenvalue)* | | | | |
| **Hypothesized No. of CE(s)** | **Eigenvalue** | **Max-Eigen Statistic** | **0.05 Critical Value** | **Prob.**** |
| None * | 0.600711 | 70.69140 | 40.95680 | 0.0000 |
| At most 1 * | 0.437371 | 44.28537 | 34.80587 | 0.0028 |
| At most 2 | 0.250024 | 22.15402 | 28.58808 | 0.2659 |
| At most 3 | 0.185502 | 15.79911 | 22.29962 | 0.3128 |
| At most 4 | 0.054275 | 4.296836 | 15.89210 | 0.9406 |
| At most 5 | 0.037961 | 2.979949 | 9.164546 | 0.5844 |
| Max-eigenvalue and Trace test indicates 2 co-integrating eqn(s) at the 0.05 level | | | | |
| * denotes rejection of the hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values | | | | |
| **Panel B** | | | | |

Normalised co-integrating coefficients of the real M3 demand equation:

$$\mathrm{Ln}(M3/P)_t = -70.420 + \underset{\substack{(1.090)\\ [4.600]}}{5.013}\,lrgdp_t + \underset{\substack{(0.024)\\ [3.040]}}{0.073}\,ltbillsa_t - \underset{\substack{(0.160)\\ [2.470]}}{0.395}\,lcpi_t - \underset{\substack{(0.144)\\ [6.560]}}{0.945}\,lexrate_t - \underset{\substack{(0.120)\\ [2.300]}}{0.276}\,lusbill_t$$

**Notes:** Standard errors in ( ) & t-statistics in [ ]

The results in panel B indicate that there is a positive relationship between income and the demand for real money for the period examined in the study. The coefficient is also statistically significant which is consistent with the apriori expectation and theory. It asserts that as income increases, people will hold more money. The coefficient of 5.013 indicates that the long-run income elasticity for real broad money is significantly greater than unity. This is consistent with Moll (2000) in a similar study on South Africa. The result supports Laidler (1993) who proposed that broader money produces higher estimates of income or wealth elasticity of the demand for money as compared to the narrow ones.

The empirical results also show that the interest rate coefficient is positive and statistically significant. This again corresponds to the apriori expectation which implies that the higher the own rate of return, the higher the demand for money in South Africa. The coefficient of cpi is negative and statistically significant, suggesting that the higher the return on alternative assets, the less the demand for money in South Africa. This is also consistent with the apriori expectation. The measures of the foreign sector in the study are all negatively related to the demand for money. This result supports the portfolio balance hypothesis of capital mobility as far as the interest rate variable is concerned. On the other hand, the sign on the exchange rate indicates the existence of currency substitution in South Africa in the event that the currency is depreciating. Both the two measures of the foreign sector are also consistent with the apriori expectation.

Table 5 reports on the Vector Error Correction model. The results indicates that the coefficient of the error correction term is negative (-0.51) and highly significant. This implies that 51 percent of the disequilibrium error is corrected within a quarter. About 17% will be corrected in the next quarter.

 

**Table 5:** The Vector Error Correction Model

| Error Correction: | D (LN_RM3) | D (LN_RGDP) | D (LN_TBILLRATE) | D (LN_CPI) | D (LN_EXRATE) | D (LN_USTBILL) |
|---|---|---|---|---|---|---|
| CointEq1 | -0.510164 | -0.121820 | 0.224500 | -0.037338 | 0.135260 | 0.252828 |
| | (0.02490) | (0.03381) | (0.08494) | (0.00934) | (0.08044) | (0.10941) |
| | [ -0.40826] | [-3.60285] | [ 2.64298] | [-3.99931] | [ 1.68144] | [ 2.31092] |
| D(LN_RM3(-1)) | -0.171658 | -0.109962 | 0.413717 | -0.016058 | -0.054163 | 1.450820 |
| | (0.13803) | (0.18747) | (0.47096) | (0.05176) | (0.44601) | (0.60659) |
| | [ -1.24363] | [-0.58656] | [ 0.87846] | [-0.31022] | [-0.12144] | [ 2.39175] |
| D(LN_RM3(-2)) | -0.049021 | 0.081486 | 1.058735 | 0.062478 | 0.581501 | 1.121846 |
| | (0.14542) | (0.19750) | (0.49616) | (0.05453) | (0.46989) | (0.63906) |
| | [ -0.33711] | [ 0.41258] | [ 2.13385] | [ 1.14567] | [ 1.23754] | [ 1.75546] |
| **Diagnostic tests** | | | | | | |
| VECM ARCH LM Tests(2) = 26.441 [0.8779]; Normality Test = 7.539165 [0.8200]; Heteroscedasticity Test: Chi squ = 1301.372 [0.4997] | | | | | | |

Table 5 also reports the diagnostic tests. The results show that the model does not suffer from normality, heteroscedasticity, and autocorrelation. This suggests that the results are robust.

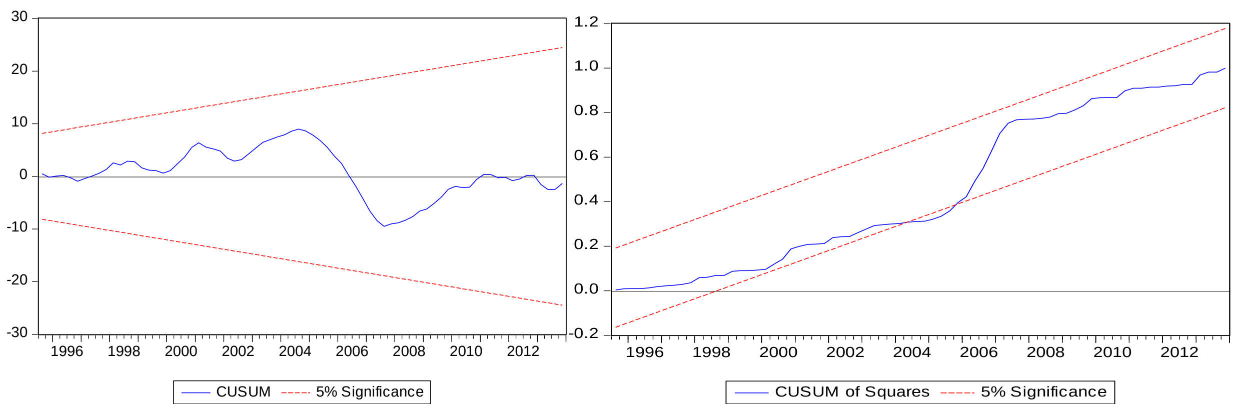


**Figure 1:** CUSUM and CUSUSMSQ Stability Tests

The CUSUM and CUSUMSQ tests were applied to determine if the money demand function is stable over the study period. Brown et al. (1975) point out that whenever the recursive residual of the estimated money demand function is outside the boundary of the critical lines, it is an indication that the money demand function is unstable. Analysing Figure 1, the CUSUM indicates that the money demand function in South Africa is stable; however, the CUSUMSQ provides evidence of instability between 2003 and 2007. This suggests that the money demand function in South Africa is unstable in some periods and justifies the use of the repo rate by the Central Bank in South Africa. Dritsaki and Dritsaki (2012) argue that in the event that the money demand function is not stable, the central bank should use the interest rate in the conduct of monetary policy.

## SUMMARY AND CONCLUSION

The study examined the money demand function in South Africa from 1994Q1 to 2012Q4. The study employed the Johansen co-integration test which indicated that there exists a relationship between the money demand function and its determinants, income (real GDP), domestic interest rate, inflation rate, foreign interest rate, and the exchange rate between the South African rand and the US dollar. The error correction coefficient indicated that 51 percent of the disequilibrium is corrected within a quarter.

The CUSUM and CUSUMSQ tests were also analysed to examine the stability of the money demand in South Africa. The results indicate that the residual plots of the money demand function under the CUSUMSQ crosses the 5% critical line. This shows that the money demand function was not stable for the period 2003 to 2007, which therefore suggests that there is some period in which the money demand function is not stable.

The results justify the use of the repo rate as an instrument of monetary policy since the broad money exhibits some element on instability. Also, the results from the long-run co-integrating equation indicate that there exists currency substitution in South Africa. Thus, foreign currencies are part of the domestic components of money supply in South Africa and using monetary aggregates as an instrument of monetary policy may expose the country to external and internal shocks.

## AUTHOR INFORMATION

**Forget Mingiri Kapingura** is a Lecturer and a Ph.D. student at the University of Fort Hare, East London campus. His research area is in International Finance, Development Finance and economic growth in emerging markets. He also has interest in financial markets and monetary economics.

## REFERENCES

1. Aron, J. and Muellbauer, J. (2006). Review of Monetary Policy in South Africa since 1994, *CSAE WPS/2006-07*.
2. Bahmani-Oskooee, M. and Sin, S. (2002). Stability of the demand for money in Korea, *International Economic Journal*, *16:2, 85 – 95.*
3. Bahmani-Oskooee, M., Rhee, H. J. (1994). Long-run elasticities of the demand for money in Korea: Evidence from co-integration analysis. *International Economic Journal, 8(2): 83-93.*
4. Brown, R. L., Durban, J., and Evans, J. M. (1975). Techniques for Testing the Constancy of Regression Relations Over Time (with discussion), *Journal of the Royal Statistical Society B,37:149-92*.
5. Contogiannis, E. and Shahi, M. A. (1982). The Demand for Money and Inflationary Expectations in South Africa, 1965-1980, *South African Journal of Economics, Vol 50:26 - 34.*
6. Courakis, A. S. (1984).The Demand for Money in South Africa: Towards a More Accurate Perspective. *South African Journal of Economics, 1(52), 1-41*.
7. Doguwa, S. I., Olowofeso, O. E., Uyaebo, S. O. U., Adamu, I., and Bada, A. (2014). Structural breaks, Co-integration and Demand for Money in Nigeria, *CBN Journal of Applied Statistics Vol.5 No.1*
8. Dritsaki, C. and Dritsaki, M. (2012). The Stability of Money Demand: Some Evidence from Turkey, *The IUP Journal of Bank Management, Vol. XI, No. 4, pp. 7-28.*
9. Friedman, M. (1959). The Demand for Money: Some Theoretical and Empirical Results. *Journal of Political Economy 67, 327-351.*
10. Handa, J. (2000). *Monetary Economics.* New York, Routledge.
11. Heller, H. R. (1966). The Demand for Money in South Africa. *The South African Journal of Economics, 34, 335-340.*
12. Hurn, A. S. and Muscatelli, V. A. (1992). The Long-run Properties of Demand for M3 in South Africa. *South African Journal of Economics, 60(2), 158-172.*
13. Ibrahim, M. H. (2001). Financial Factors and the Empirical Behavior of Money Demand: A Case Study of Malaysia, *International Economic Journal*, *15:3, 55-72.*
14. Laidler, D. E. W. (1993). The *Demand for Money: Theories, Evidence and Problems*, 4th edition. New York, Harper, Collins College Publishers.
15. Maxwell, T. (1971). The Long-Run Demand for Money in South Africa (1918-19600: Some Preliminary Findings. *South African Journal of Economics, 39, 13-30.*
16. Moll, P. G. (2000). The Demand for Money in South Africa: Parameter Stability and Predictive Capacity. *The South African Journal of Economics, 68(2), 190-208.*
17. Mutsau, I. (2013). *Empirical Analysis of Money Demand in South Africa (1980-2011): An Autoregressive Distributed Lag Approach*. Masters Dissertation, University of Zululand.
18. Niyimbanira, F. (2013). Money demand in South Africa Revisited: Analysis of Different Models, *International Business & Economics Research Journal, 12(4), 427 -438.*

19. Onafowora, O. and Owoye, O. (2011). Structural Adjustment and the Stability of the Nigerian Money demand Function, *International Business & Economic Research Journal, 3(8), 55 – 64.*
20. Poole, W. (2006). 'Inflation targeting,' speech delivered to Junior Achievement of Arkansas, Inc., Little Rock, Arkansas, 16th February 2006. Published in Federal Reserve Bank of St. Louis Review, 88(3).
21. Stadler, G. (1981). The Demand for Money in South Africa. *South African Journal of Economics, 49(2), 145-152.*
22. Stals, C. (1999). Statement on Reserve Bank Accommodation Procedures, 23 June, 1999. *Quarterly, Bulletin,* South African Reserve Bank, June: 62.
23. Tavlas, G. S. (1989). The Demand for Money in South Africa: a Test of the Buffer Stock Model. *South African Journal of Economics, 57(1), 1-13.*
24. Thomas, L. (1985). Portfolio Theory and Currency Substitution, Journal of Money, Credit and Banking, 17:3, 247 357.
25. Whittaker, J. (1985). The Demand for Money in South Africa: Towards a More Accurate Perspective. *South African Journal of Economics, 53(2), 184-196.*

## APPENDIX

**Table A:** Lag Length Selection Criteria

| **VAR Lag Order Selection Criteria** | | | | | | |
|---|---|---|---|---|---|---|
| **Endogenous Variables: LN_RM2 LN_RGDP LN_EXRATE LN_CPI LN_TBILLRATE** | | | | | | |
| Exogenous Variables: C | | | | | | |
| Date: 07/28/14 Time: 13:56 | | | | | | |
| Sample: 1990Q1 2013Q4 | | | | | | |
| Included Observations: 88 | | | | | | |
| **Lag** | **LogL** | **LR** | **FPE** | **AIC** | **SC** | **HQ** |
| 0 | 235.0294 | NA | 3.69e-09 | -5.227940 | -5.087182 | -5.171232 |
| 1 | 929.7361 | 1294.681* | 9.07e-16* | -20.44855* | -19.60400* | -20.10830 |
| 2 | 964.9646 | 61.64983 | 7.22e-16 | -20.68101 | -19.13268 | -20.05723 |
| 3 | 979.2647 | 23.40014 | 9.34e-16 | -20.43783 | -18.18571 | -19.53051 |
| 4 | 1043.191 | 97.34210 | 3.96e-16 | -21.32252 | -18.36661 | -20.13166* |
| 5 | 1079.186 | 50.72114 | 3.22e-16 | -21.57242 | -17.91272 | -20.09802 |
| 6 | 1102.223 | 29.84325 | 3.60e-16 | -21.52780 | -17.16431 | -19.76986 |
| 7 | 1138.239 | 42.56355 | 3.09e-16 | -21.77815 | -16.71087 | -19.73667 |
| 8 | 1169.011 | 32.87059 | 3.10e-16 | -21.90934 | -16.13828 | -19.58433 |
| * indicates lag order selected by the criterion | | | | | | |
| LR: sequential modified LR test statistic (each test at 5% level) | | | | | | |
| FPE: Final prediction error | | | | | | |
| AIC: Akaike information criterion | | | | | | |
| SC: Schwarz information criterion | | | | | | |
| HQ: Hannan-Quinn information criterion | | | | | | |

**NOTES**